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DOI: https://doi.org/10.1111/conl.12647

Received: 31 October 2018 | Accepted: 26 March 2019

DOI: 10.1111/conl.12647

Conservation Letters
A journal of the Society for Conservation Biology
Open Access
WILEY

LETTER

Easement or public land? An economic analysis of different ownership modes for nature conservation measures in California

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Abstract

Biodiversity conservation requires space where conservation measures are implemented for a desired purpose. Setting land aside for conservation has been widely applied, while novel conservation modes (private–public partnerships, private multipurpose land management) may be fundamental to achieve conservation goals. We perform an economic analysis of the cost development for two conservation options in California, in-fee and easements, from 1970 to today. We find that in-fee options have lower costs than easements in the long run. While there are high costs of purchase for in-fee, ultimately they even-out or generate profits. Costs of easements continue growing exponentially overtaking costs of purchase. Sensitivity analysis shows increases in purchasing prices and opportunity costs positively influencing conservation costs, while increasing interest rates negatively influence them. The results suggest that easements are not yet an economically viable alternative for in-fee conservation purchases. Our analysis is a first step to assess economic viability of choosing easements.

KEYWORDS

cost-effectiveness, land acquisition, modes of governance, ownership

1 | INTRODUCTION

Conservation of biodiversity as a basic need requires space, on which conservation measures are implemented. Systematic conservation planning has defined conservation goals and optimal solutions to reach such goals (Pressey, Cabeza, Watts, Cowling, & Wilson, 2007). Goals include representation of biodiversity and its processes and functions; solutions involve identifying an optimal set of lands that best meets the defined conservation goals, strategizing when and how to add them to a conservation network, and ultimately acquiring and managing land (Lovejoy, 2006; Pressey et al., 2007). While setting goals is relatively straightforward, implementing them can be challenging, and among other things, determines land governance, i.e., ownership. Ownership of this space is an important factor influencing the costs of implementation (Adams, Pressey, & Naidoo, 2010; Naidoo et al., 2006), the duration of conservation measures, and the ecological and economic success of conservation projects (Balmford, Gaston, Blyth, James, & Kapos, 2003). However, few studies have assessed the economics of conservation, in particular when the options are to purchase public land or to lease private land as easements or covenants (Cross, Keske, Lacy, Hoag, & Bastian, 2011; Iftekhar, Tisdell, & Gilfedder, 2014). Here, we assess which is the best option from an economic perspective: to purchase as public land or to lease as easements?

To maximize ecological outcomes, while not placing an ever-growing burden on taxpayers or relying on donations for purchases to be achieved by NGO's, a cost-effective implementation of conservation goals is desirable. Such

implementation would either maximize ecological benefits at predefined costs or minimize costs for a given and desired ecological outcome (Wätzold & Schwerdtner, 2005). The optimal design of conservation measures can be achieved by, for example, the design of agri-environmental schemes (Armsworth, 2014; Naidoo et al., 2006), spatial and temporal allocation (Drechsler, Johst, & Wätzold, 2017, Mouysset, Doyen, Jiguet, Allaire, & Leger, 2011; Polasky et al., 2008), optimal length of conservation contracts (Ando & Chen, 2011; Lennox & Armsworth, 2011), and efficiency gains from variable payment structures (Armsworth et al., 2012). A so far neglected area of research is the influence of the mode of governance on the optimality of conservation measures. The question, whether conservation agencies should either buy land and manage it themselves, or monetarily compensate landowners that voluntarily provide conservation measures is an important issue (Muradian & Rival, 2012; Schöttker, Johst, Drechsler, & Wätzold, 2016). Studies so far formalized the cost-relation of buying land versus compensating landowners and identified influencing economic factors (Schöttker & Wätzold, 2018), highlighted the effects of land markets and property value fluctuations on opportunity costs (Curran, Kiteme, Wünscher, Koellner, & Hellweg, 2016), and provided a general framework for comparing conservation contracts with different modes of governance (Juutinen, Mäntymaa, Mönkkönen, & Svento, 2008). Nonetheless, the exact implementation of monetary compensations might have a large effect on the costs of conservation (Engel, Pagiola, & Wunder, 2008; Wätzold & Drechsler, 2005).

In this work, we provide an overview of different modes of governance for conservation relevant in the state of California, and discuss the costs and costs-structure of a selection of conservation areas. In principle, in-fee land causes relatively high upfront one-time costs, while easements cause relatively small, but recurring costs. By calculating the present value of both cost streams, the upfront one-time costs are (depending on the discount schedule) valued differently than the recurring costs and thus cause different present values and cost developments. We expect land purchase to have a different present value of cost per hectare than easements because of lower vulnerability to volatile costs and because of differences in recurring and one-time costs. We chose California because of the wealth of conservation action over the past 100 years resulting in about one third of the state being conserved in both public and private ownerships (Santos, Watt, & Pincetl, 2014). Land in the state has a positive value, as each purchase is weighted against development claims, and prices are growing exponentially. Recent efforts for conservation include easements, which allow private landowners to offset the easement investment against tax liabilities that result in foregone tax payments for the government, and relief government and NGOs from expensive land purchases. This decision is currently ongoing in California but also in many other regions of the world. Easements are also expected to increase stewardship (Merenlender, Huntsinger, Guthey, & Fairfax, 2004; Sorice et al., 2013; von Hase, Rouget, & Cowling, 2010). We chose to analyze only buying or leasing alternatives because they represent the most extreme conservation decisions, therefore likely provide a wide range of costs of conservation. In our calculation, we included acquisition costs, land management costs, transaction costs, and potential income. We present results in a way that makes the alternatives more comparable (e.g., total and per hectare costs over some finite time period). We discuss our findings in light of current economic choices and limitations unveiled by a sensitivity analysis, and then tackle the unobservable, heterogeneous nature of opportunity costs to private land managers of switching to conservation easements (hidden information creating opportunities for rent seeking).

2 | METHODS

2.1 | Study system

California is a biodiversity hotspot (Myers, Mittermeier, Mittermeier, da Fonseca, & Kent, 2000) and while facing pressures to develop, one third of the state area is under conservation (Figure 1). Most conservation area is public land but a part is easements. We selected four conservation organizational bodies to account for the diversity of governance levels on decisions of land acquisition, which we assume to generate equal ecological benefits when implementing conservation measures. We chose the California Department of Parks and Recreation as a representative of state level governance, the County of San Diego as a representative of county level governance, the City of San Diego to represent city level governance, and the East Bay Regional Park District (EBRPD) as a representative of a Special District. Currently it is possible to negotiate a contract with land owners for a property to become a conservation easement. Conservation easements in the state currently amount to 8000 km^2. Unfortunately, it was not possible to include NGOs such as The Nature Conservancy in our analysis because of the lack of available data on land purchase prices and other costs; however, we do acknowledge that this would have been a valuable exercise as these NGOs are major actors in easement conservation in the United States. Nonetheless, we were interested in the choice for purchase or easement, irrespectively on whether agencies are NGOs, so we believe our analysis is still interesting and provides valuable insights beyond the current perception that easements are NGO-only options. Further, there is no reason to expect that the buying processes would differ between NGOs and other agencies, only varying the funding sources and the mechanisms to bring in participants to easement schemes.

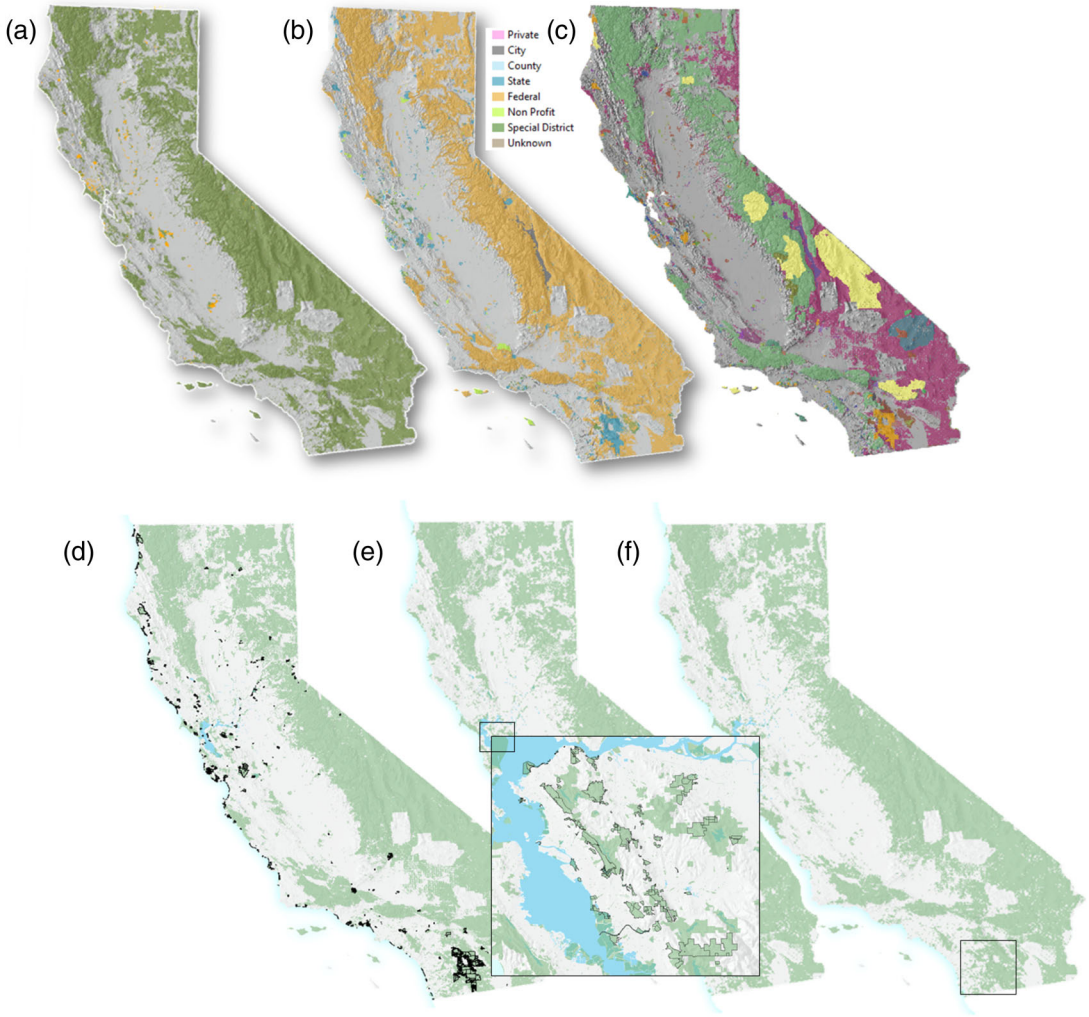

FIGURE 1 Conservation areas in the state of California: (a) extent of conservation areas (green) and easements (orange); (b) ownership of conservation parcels (legend colors represent governance levels responsible for management of land); (c) type of land management (yellow: national parks; purple: Bureau of Land Management; green: United States Forest Service; orange. state parks; grey: United States Department of Defense); (d) California Department of Parks and Recreation properties; (e) East Bay Regional Park District properties; and (f) City and County of San Diego. The California State Parks manages about 900 properties that were added to their portfolio since 1970, corresponding to 792 km^2 distributed throughout the state. The agency has an Office of Grants and Local Services that since 1964, has provided funding to 7,400 local parks to be created or improved. The County of San Diego currently manages about 200 properties, amounting to 207 km^2 of land managed since 1970. The county faces high rates of development and it is ambitious and determined to increase the area in Open Space, as stated in its strategic plan. The City of San Diego manages 430 properties with about 190 km^2 of land added since 1970. In California, cities decide upon land use regulations within their jurisdiction (Santos et al., 2014), and San Diego manages most of the City Parks. The East Bay Regional Park District (EBRPD) is a Special District, that is, a limited purpose local government 1 separate from cities and counties. Special districts provide focused public services such as fire protection, water supply, parks, recreation, and so on. EBRPD manages 242 properties with an area of 222 km^2 added since 1970. Financing for Special Districts comes from property taxes, fees that users pay for services and special assessments. These types of districts may handle a revenue that varies between 10and 30 billion USD, but only a small fraction of that budget goes into parks and recreation

2.2 | Costing functions

We adapt the cost functions of Schöttker and Wätzold (2018), who provide a framework of costing relations, relevant in the assessment and estimation of costs of conservation implementation. Under this framework, the general nature of costs differs according to governance mode, and provides a functional relationship for the costs of conservation, if the land purchased versus land owned privately, and is compensated monetarily for the voluntary provision of conservation.

To assess the costs of a conservation project, the opportunity costs of implementation have to be calculated. Generally relevant cost components are one-time costs—e.g., purchasing expenses, contract negotiation costs, transaction costs—and recurring costs—e.g., monitoring costs, land management costs, contract renegotiation costs. Depending on when

the different costs arise, they have to be discounted and brought into a common metric to make them comparable over time (one Dollar in 1950 has a different value as one Dollar in 2018). After discounting, all one-time and recurring costs can be accumulated to calculate the overall costs of a project.

We can thus simplify the general structure of the opportunity costs as follows:

$$C = \sum_{t=t_{start}}^{t_{end}} C_t \times d_t \quad (1)$$

with C_t the general costs within a project at time t, and d_t the relevant discount factor at time t defined as follow, with i_{t-1} the real interest rate in year $t-1$:

$$d_t = \left(1 + i_{t-1}\right)^{-1} \times d_{t-1} \text{ with } d_{t_{start}} = 1 \quad (2)$$

In general, we consider only economic costs to be discounted and neglect ecological benefit discounting, as no detailed information is available on when and which scale ecological benefits arise, and because of the permanent nature of conservation areas generating ecological benefits (Armsworth, 2018). This structure can then be used to reflect the different cost structures of land that has been bought by an agency and henceforth managed by themselves ("in-fee"), or land for which private owners are compensated for conservation ("easement").

2.2.1 | Costs of "in-fee" land management

Land purchase causes a mixture of one-time expenditure and recurring cost components, together resulting in overall costs of implementation and execution of a conservation project. We calculate the costs $C^{in\ fee}$ of "in-fee" conservation projects as follows:

$$C^{in\ fee} = \sum_{t=t_{start}}^{t_{end}} \left(P_t + M_t + S_t + T_t^{in\ fee} - I_t\right) \times d_t \quad (3)$$

with P_t, the purchasing costs of land; S_t, the purchasing side costs (e.g., contract negotiation, notary fees, taxes, etc.); M_t, the regularly recurring management costs; $T_t^{in\ fee}$, the transaction costs of the purchase; and I_t, the potential income generated from managing the conservation measures. Forgone agricultural profits are included in the income calculation (Supporting Information Section 2). The income is calculated as a fraction of the opportunity cost (by a scaling factor l) and thus is interpreted as a reduced income (compared to non-conservation use).

2.2.2 | Costs of "easement" land management

We calculate the costs $C^{easement}$ caused by a compensation scheme as follows:

$$C^{easement} = \sum_{t=t_{start}}^{t_{end}} \left(OC_t + M_t + T_t^{easement,\,a} + T_t^{easement,\,l} - I_t\right) \times d_t \quad (4)$$

with OC_t, the opportunity costs for the landowner by managing land for conservation and thus not profit-maximizing; M_t, the management costs; the agency side transaction costs $T_t^{easement,\,a} = t_a^{easement} \times OC_t$; and $T_t^{easement,\,l} = t_l^{easement} \times OC_t$, the land user side transaction costs (see Supporting Information).

2.3 | Data description

Due to constraints on the data, as well as to historical reasons, we decided to only focus on areas set under conservation after 1969. After this year, state allowed public–private partnerships for the first time, a necessary step for conservation easements to be possible. This is also the time frame for which there is reliable data available on land values, interest rates, and inflation rates, which are required to calculate the costs of either management option.

We estimated the actual land purchasing prices according to Equation (3) based on average county level housing price data Davis and Heathcote (2007) (https://www.car.org/marketdata/data/countysalesactivity/). The discount factor is based on the 10-year treasury constant maturity, non-seasonally adjusted rate (https://fred.stlouisfed.org/series/DGS10) and the consumer price index for all urban US consumers (https://data.bls.gov/pdq/SurveyOutputServlet). Data on conservation areas were provided by the California Protected Areas Data Portal (CPAD, GreenInfo Network 2014, http://www.calands.org) and the California Conservation Easements Datasets (CCED, GreenInfo Network, 2014).

3 | RESULTS

Overall, costs of implementation, total annual costs, costs of management, and total annual management costs all show that easements surpass the costs of in-fee properties in the long run, showing an exponential growth while costs of in-fee are more volatile, decreasing substantially after a decade. We found very similar patterns across agencies; however, they became more different as we estimated costs per unit of area.

3.1 | Development of total annual costs

When looking at the development of total annual costs and total annual costs per hectare (Figure 2), the described cost

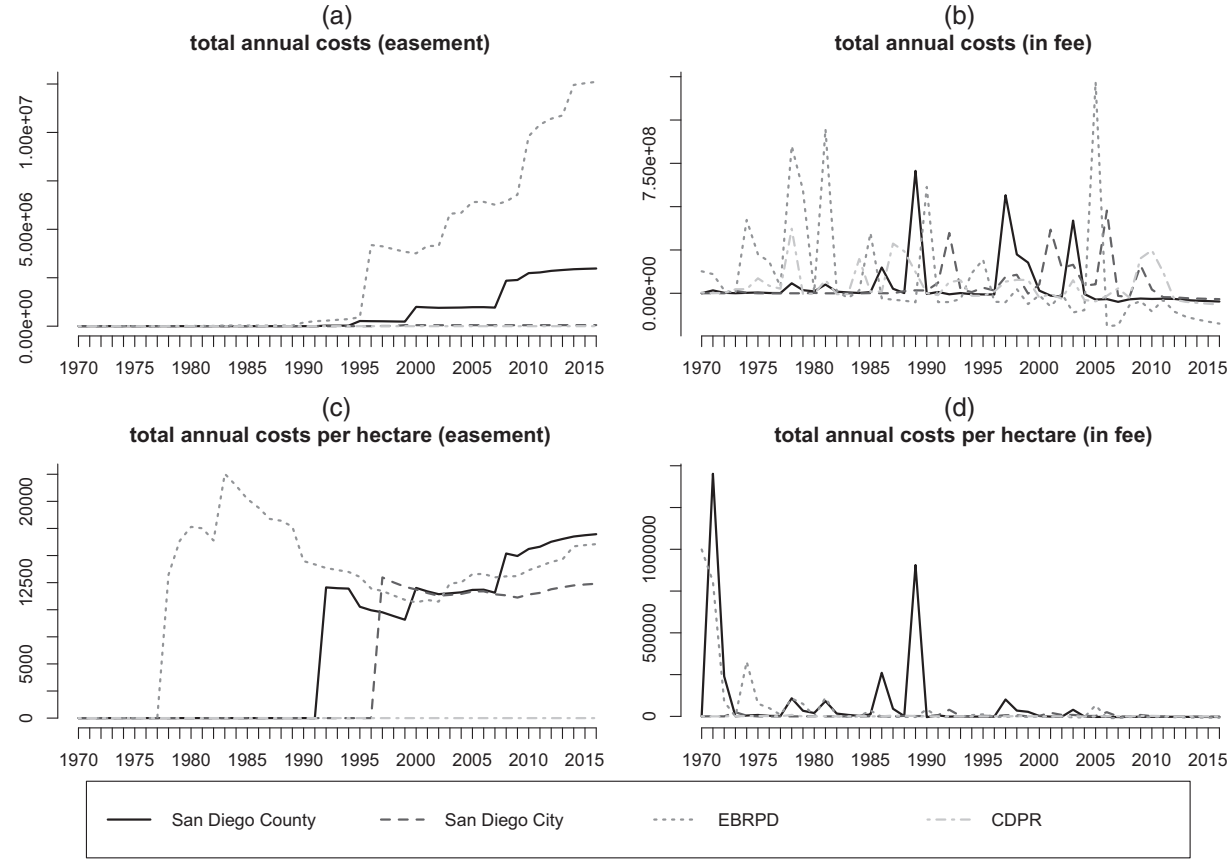

FIGURE 2 Total annual costs ((a) and (b)), i.e. the total amount of costs which arise in each year of the analysis time frame, separated for each of the four conservation agencies, and total annual costs per hectare ((c) and (d)), i.e. the total amount of costs in each year of the conservation time frame, divided by the total area in hectare in that year, separated for each of the four conservation agencies.

characteristics are supported. Easement costs start late and increase over time, while in-fee costs start early and fluctuate strongly, even generating negative costs (i.e., income). Per hectare, easement, and in-fee total costs are of comparable size suggesting that although conservation was implemented in heavily different economic and ecological conditions, eventual costs per hectare are not influenced by potential governance differences. We believe this assumption is transferable elsewhere because land costs are market driven and independent of conservation agencies, their goals, and jurisdiction.

With easement, management total annual costs are constantly positive (although income of the same relative amount is considered as with "in-fee"), and even increase, while with "in-fee", annual costs are highly volatile and fluctuate from positive to negative (i.e., income generating) over the analyzed time frame, on a total and per hectare basis.

3.2 | Development of costs of conservation

The total cumulative costs of conservation and their temporal development for both options are different (Figure 3). While the total cumulative costs of easements show an exponential development, those for in-fee areas are more volatile. This volatility is shown as costs of implementation for in-fee properties can increase drastically when new areas are purchased or even decrease due to relatively low maintenance costs and relatively high potential-income generated. We found a consistent pattern across agencies, except for agencies without easements.

As both options, however, are based on hugely different amounts of conservation area—i.e., 965 ha in easements and 136,198 ha in-fee in 2016—a comparison of total costs delivers an incomplete picture. On a per hectare basis, it can be seen that while easements start generating relatively low costs that are increasing over time, the in-fee start relatively high (even when the huge fluctuations in early years are neglected) and decrease over time. Surprisingly the total cumulative costs per hectare for easements increases over time for all agencies, while in-fee total cumulative costs per hectare consolidate in later years, after being relatively volatile in early years.

There are two governance modes that are outstanding in the development of their costs per hectare, EBRPD for easements and San Diego county for in-fee alternatives. EBRPD follows two exponential periods, the first until 1992 and the later still ongoing. San Diego county shows two peaks of investment, first in the 1970s and the second in the 1990s.

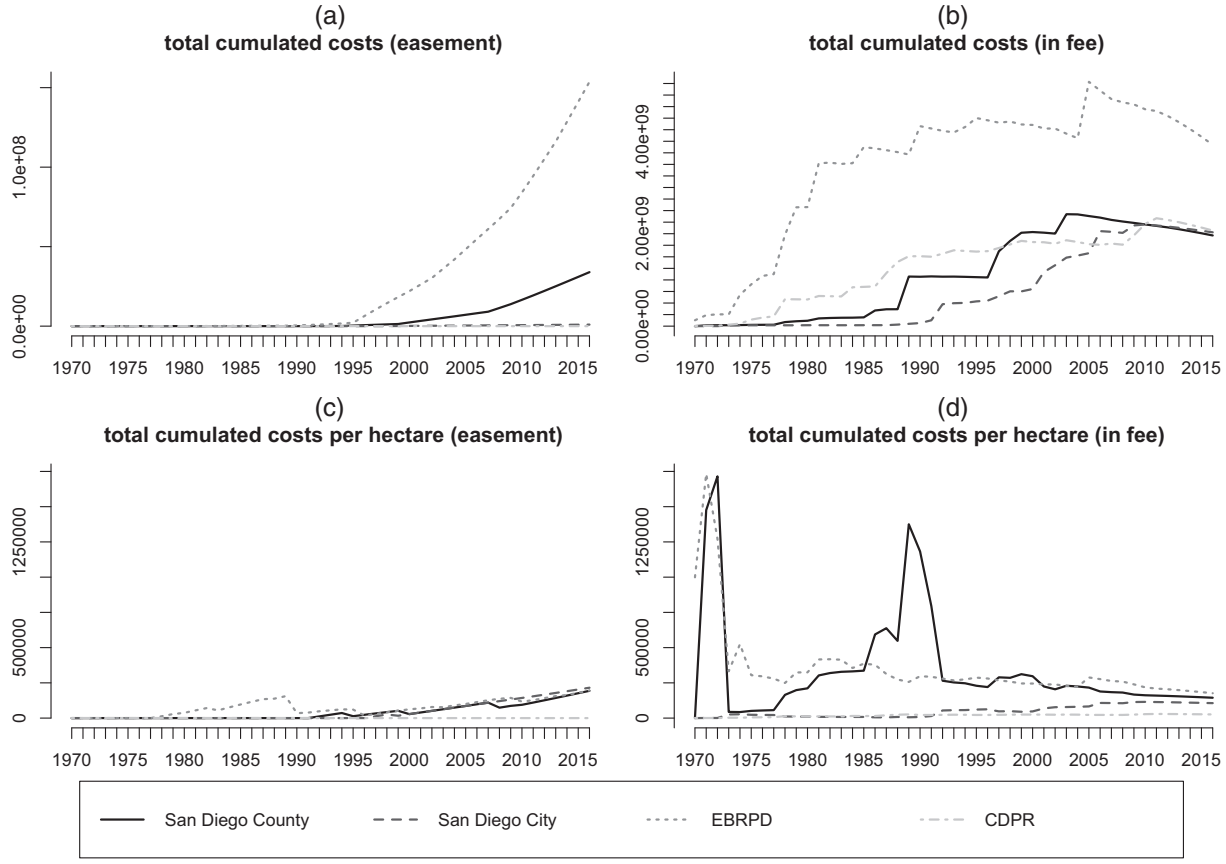

FIGURE 3 Total cumulative costs and total cumulative costs per hectare of implementing and managing easements or in-fee conservation areas.

3.3 | Development of costs of management

Substantial fluctuations in management costs (i.e., costs for implementing and running conservation measures) only arise in early years of conservation on a per hectare basis (Figure 4). At the same time, the total amount of management costs is marginal and thus seems negligible for three of the agencies, with the exception of EBRPD easement and the California Department of Parks and Recreation in-fee. Although management costs are lower on a per hectare basis for in-fee than for easements, total costs of conservation are not majorly driven in either case by the management costs.

Annual management costs (Figure 5) also show a generally noncomparable development over time. While, on a per hectare basis, management costs of easement in 2016 were between 100 and 900 $ per ha, with in-fee these ranged between 1 and 25$. Also the maximum values, in a total and per hectare, show substantially different general development patterns.

3.4 | Sensitivity analysis

We find that variation in purchasing prices and opportunity costs have a rather large influence on the different cost measures and especially total and total per hectare costs (both annually and cumulative), while the impact from variations in interest and discount rates, income, and transaction costs is rather small and even negligible (see Supporting Information).

4 | DISCUSSION

We present an economic framework to analyze the costs of acquisition of land for conservation on private versus public land and how they are influencing decisions. Overall, total annual costs, costs of management, and total annual management costs all show that easements surpass the costs of in-fee properties in the long run, with an exponential growth while costs of in-fee are and higher for purchase but decrease substantially after a decade. This suggests that from an economic point of view, easements are not a preferable option, mainly due to the high share of recurrent costs. We, furthermore, find that management costs are not a major discriminating factor between both governance modes as they are of relatively low importance in relation to other cost components.

Previous studies have shown a diversification of land acquisition options since 1990s. Easements or other public–private partnerships have been suggested because some ecosystems

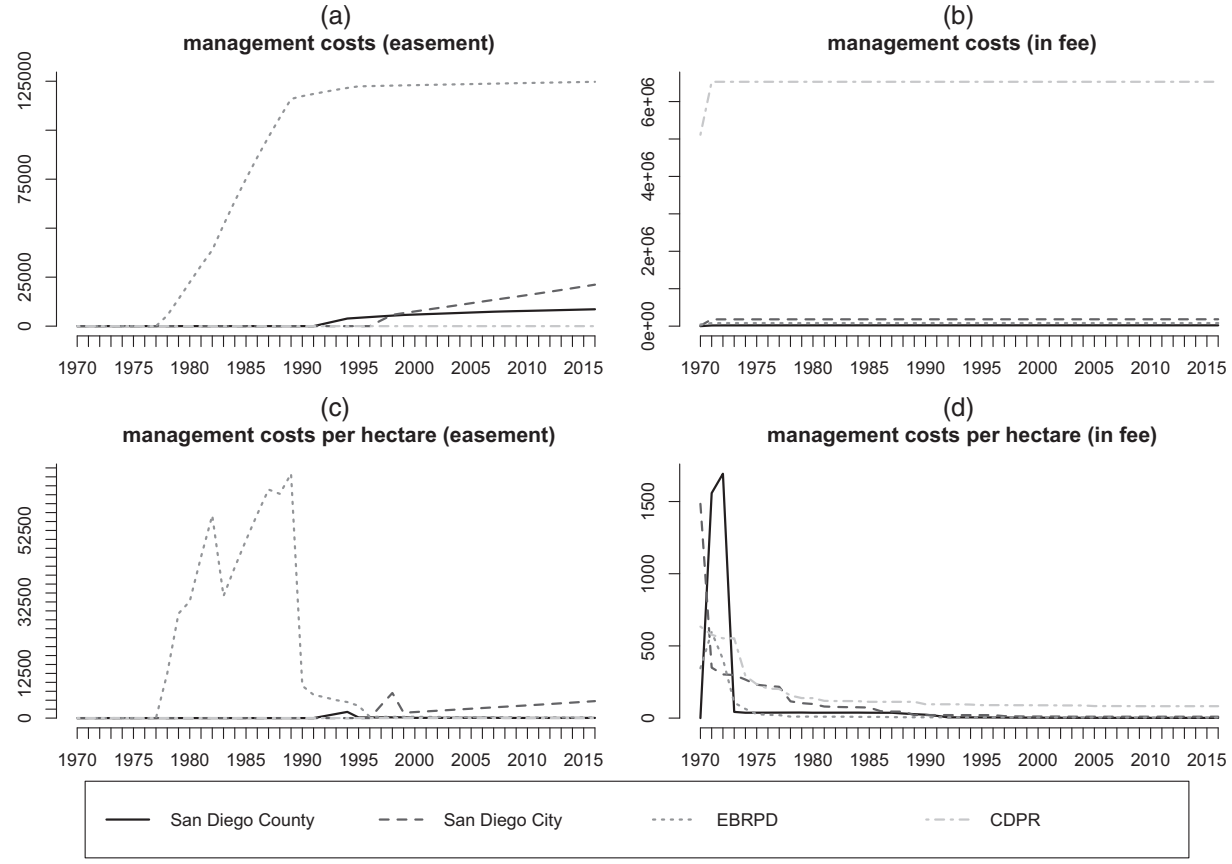

FIGURE 4 Development of cumulative management costs with easement management (a) and cumulative management costs with in-fee managed areas. Management costs are calculated according to eq. (A2) (see Online Supplementary Material) separately for each area and cumulative over time for each agency. Development of per hectare management costs with easement management (c) and per hectare management costs with in-fee management (d). While all agencies do at least manage some easements, no data was available for the CDPR in the considered timeframe.

only occur in current private land not available for sale (Nolte, 2018). However, more information is needed on this incentive-based strategy to invest in acquiring partial interest in private land for conservation purposes (Merenlender et al., 2004). We find that from an economic point of view, easements are not a good option in the long run mainly due to the high share of recurrent costs, suggesting that, depending on economic factors like interest and inflation rates, buying land for conservation is cheaper than compensating landowners (Schöttker, Johst, Drechsler, & Wätzold, 2016). These increased costs of easements could be because of their purchases at a time of rapid increase in land costs (Abraham & Hendershott, 1992). In our analysis, we only accounted for costs of purchase and management in conservation easements. However, if easements are also productive land and result in private purchase, these factors could be counted in the cost to better reflect the economics of these lands. Further, it could be that easements are economically viable when land prices are stable or increasing at a slower pace than in California. California housing market has plummeted since 1980s and with it the value of land (Quigley & Raphael, 2005). The easement option could also work if there are market controls on land prices aimed at lowering conservation land costs in comparison to productive and development land.

The economic options are surprisingly similar across management agencies; however, they differ per unit of area. Each of the governance modes have different costs and costs-structure, and the framework is only limitedly applicable to compare cost developments between agencies, given heterogeneity in conservation conditions (Santos et al., 2014). This is because different agencies have different missions and goals, and also target different types of land fee or geographical regions, and are able to access different funding sources. Different starting points of individual conservation areas also make cost comparison difficult, for example, due to a different total conservation time frame or discounting of historical cost components. However, this is the reality of most conservation land acquisition, as it is often not possible to acquire all land at the same time. This also complicates the comparison of costs on an annual basis, which is additionally driven by economies of scale and maybe other scaling factors. It must be noted that land owners might engage in rent seeking behavior by overstating their opportunity costs and thus causing increasing purchasing prices and compensation requests

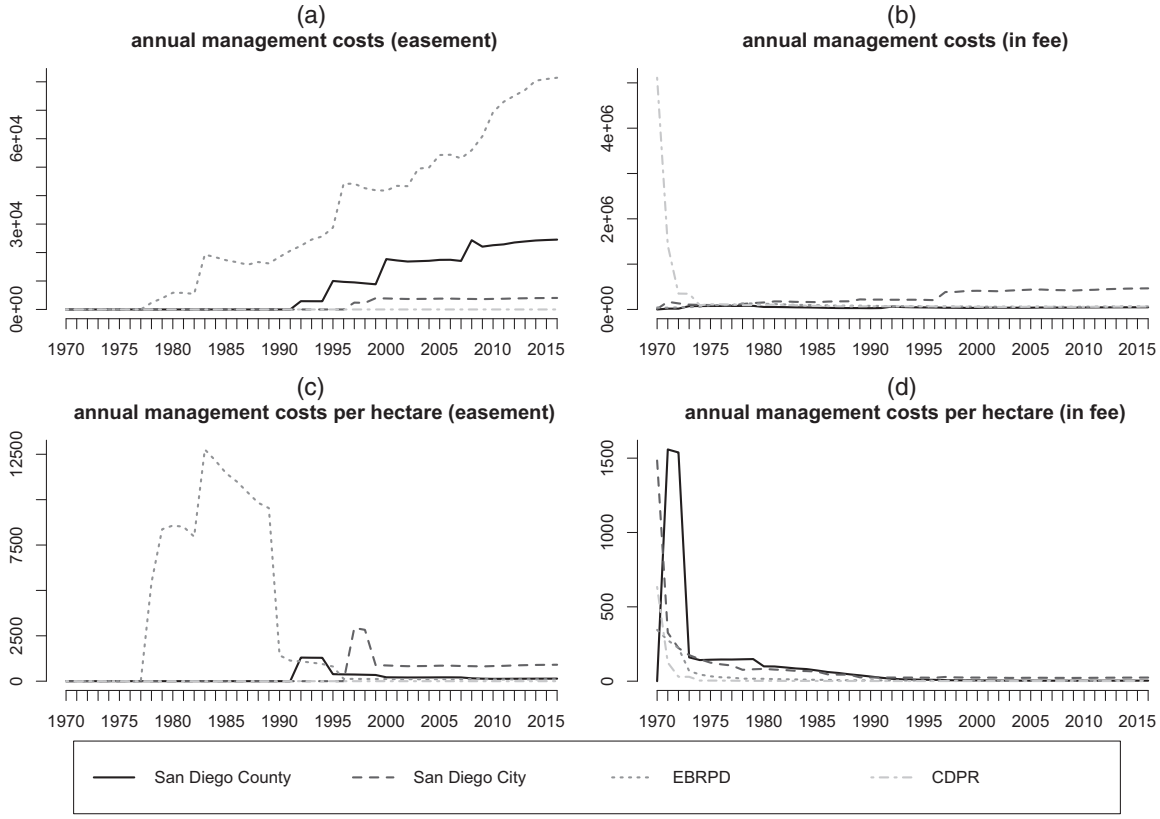

FIGURE 5 Annual management costs and annual management costs per hectare for each management option.

(Ferraro, 2008). How far this behavior is prevalent in the study area or how agencies counteract is an open question.

Our description of costs and their development over time for conservation in different governance modes and conservation agency settings in California highly depends on available data. The quality of data on easements hampered a deeper quantitative analysis, while still unveiling the general development of costs. Increased data availability can improve cost estimation and reveal governance mode dependencies. Upon that, the conceptual character of the used cost estimation framework allows for an understanding of cost components and development for a subset of conservation actions, while having the potential for improvement by better information on cost characteristics. The costing framework is generally applicable to describe the individual cost patterns of one agency at a time and to compare management modes.

Easement implementation, although potentially beneficial from an ecological and social perspective, is relatively costly. Investing the same monetary amounts in land purchases can increase ecological benefits, by keeping the economic costs constant and increase efficiency. Local legislation to allow and incentivize long-term investments into land acquisition would also reduce long-term budgetary burden on national and state finances, let alone the many economic reasons for and spill-overs from nature conservation (Balmford et al., 2002). In how far implementation into legislation or conservation planning is happening, in general or in special in California, is however an open issue.

ACKNOWLEDGEMENTS

The authors thank Christoph Nolte for bringing the authors into contact and allowing this research in the first place. The authors thank the Spatial History Project and the Bill Lane Center for the American West at Stanford University for the information on conservation history in California.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

How to cite this article: Schöttker O, Santos MJ. Easement or public land? An economic analysis of different ownership modes for nature conservation measures in California. *Conservation Letters*. 2019;12:e12647. https://doi.org/10.1111/conl.12647